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Anisotropic strains, metal-insulator transition, and magnetoresistance of $La_{0.7}Ca_{0.3}MnO_3$ films

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Thin films of perovskite manganite $La_{0.7}Ca_{0.3}MnO_3$ were grown epitaxially on $SrTiO_3$(100), MgO(100) and $LaAlO_3$(100) substrates by the Laser Molecualr Beam Epitaxy. Microscopic structures of these thin film samples were determined by x-ray diffraction measurements. The unit cells of these films have different shapes, i.e., contracted tetragonal, cubic, and elongated tetragonal for $SrTiO_3$, MgO, and $LaAlO_3$ cases, respectively, while the unit cell of the bulk is cubic. In addition, the transition temperature of the metal-insulator transition depends sensitively on the strain in the lattice. It is found that the samples with cubic unit cell show smaller peak magnetoresistance at low fields ($\lesssim 1$ T) than the noncubic ones do. The present result demonstrates that the magnetoresistance of $La_{0.7}Ca_{0.3}MnO_3$ at low fields is sensitive to the strain effects and therefore can be controlled by lattice distortion via externally imposed strains [1]. The underlying physics will be discussed in terms of the Jahn-Teller effect.

[1] T. Y. Koo, S. H. Park, K. -B. Lee, Y. H. Jeong, Appl. Phys. Lett. 71, 977 (1997)